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FEDERAL COMMUNICATIONS COMMISSION

47 CFR Part 15

[ET Docket No. 13-49; FCC 13-22]

Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band

AGENCY: Federal Communications Commission.

ACTION: Proposed rule.

SUMMARY: This document proposes to amend the Commission's rules governing the operation of Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band. The Commission has gained much experience with U-NII devices since it first made spectrum available in the 5 GHz band for U-NII in 1997. The Commission believes that the time is now right to revisit the rules. The initiation of this proceeding satisfies the requirements of the "Middle Class Tax Relief and Job Creation Act of 2012" which requires the Commission to begin a proceeding to modify the rules to allow unlicensed U-NII devices to operate in the 5350-5470 MHz band. The Commission believes that an increase in capacity gained from 195 megahertz of additional spectrum, combined with the ease of deployment and operational flexibility provided by its U-NII rules would continue to foster the development of new and innovative unlicensed devices, and increase wireless broadband access and investment.

DATES: Comments must be filed on or before **[INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, and reply comments must be filed on or before **[INSERT DATE 75 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

FOR FURTHER INFORMATION CONTACT: Aole Wilkins, Office of Engineering and Technology, (202) 418-2406, e-mail: Aole.Wilkins@fcc.gov, TTY (202) 418-2989.

ADDRESSES: You may submit comments, identified by ET Docket No. 13-49, by any of the following methods:

- Federal Communications Commission's Web Site: http://fjallfoss.fcc.gov/ecfs2/. Follow the instructions for submitting comments.

- Mail: Aole Wilkins, Office of Engineering and Technology, Room 7-A431, Federal Communications Commission, 445 12th SW, Washington, DC 20554.
- People with Disabilities: Contact the FCC to request reasonable accommodations (accessible format documents, sign language interpreters, CART, etc.) by e-mail: FCC504@fcc.gov or phone: 202-418-0530 or TTY: 202-418-0432.

For detailed instructions for submitting comments and additional information on the rulemaking process, see the SUPPLEMENTARY INFORMATION section of this document.

SUPPLEMENTARY INFORMATION: This is a summary of the Commission's Notice of Proposed Rule Making, ET Docket No. 13-49; FCC 13-22, adopted February 20, 2013, and released February 20, 2013. The full text of this document is available for inspection and copying during normal business hours in the FCC Reference Center (Room CY-A257), 445 12th Street, SW., Washington, DC 20554. The complete text of this document also may be purchased from the Commission's copy contractor, Best Copy and Printing, Inc., 445 12th Street, SW., Room, CY-B402, Washington, DC 20554. The full text may also be downloaded at: www.fcc.gov.

Pursuant to §§ 1.415 and 1.419 of the Commission's rules, 47 CFR 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). See Electronic Filing of Documents in Rulemaking Proceedings, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: http://fjallfoss.fcc.gov/ecfs2/.
- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number. Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-

class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.

People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

Summary of Notice of Proposed Rulemaking

1. By the Notice of Proposed Rulemaking (NPRM), the Commission proposes to amend part 15 of its rules governing the operation of Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band. U-NII devices are unlicensed intentional radiators that operate in the frequency bands 5.15-5.35 GHz and 5.47-5.825 GHz, and which use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions. Since the Commission first made available spectrum in the 5 GHz band for U-NII in 1997, it has gained much experience with these devices. The Commission believes that the time is now right to revisit the part 15 rules, and, in the NPRM, proposes to modify certain technical requirements for U-NII devices to ensure that these devices do not cause harmful interference and thus can continue to operate in the 5 GHz band and make broadband technologies available for consumers and businesses.

2. The Commission also seeks comment on making available an additional 195 megahertz of spectrum in the 5.35-5.47 GHz and 5.85-5.925 GHz bands for U-NII use. This could increase the spectrum available to unlicensed devices in the 5 GHz band by approximately 35 percent and would represent a significant increase in the spectrum available for unlicensed devices across the overall radio spectrum. The initiation of this proceeding satisfies the requirements of section 6406 (a) of the "Middle Class Tax Relief and Job Creation Act of 2012" which requires the Commission to begin a proceeding to modify part 15 of title 47, Code of Federal Regulations, to allow unlicensed U-NII devices to operate in the 5350-5470 MHz band. The Commission believes that an increase in capacity gained from 195 megahertz of additional spectrum, combined with the ease of deployment and operational flexibility provided by its U-NII rules would continue to foster the development of new and innovative unlicensed devices, and increase wireless broadband access and investment.

Background

3. Part 15 of the Commission's rules permits the operation of radio frequency devices without issuing individual licenses to operators of these devices. The Commission's part 15 rules are designed to ensure that there is a low probability that these devices will cause harmful interference to other users of the same or adjacent spectrum. Typically, unlicensed devices operate at very low power over relatively short distances, and often employ various techniques, such as dynamic spectrum access or listen-before-talk protocols, to reduce the interference risk to others as well as themselves. The primary operating condition for unlicensed devices is that the operator must accept whatever interference is received and must correct whatever interference it causes. Should harmful interference occur, the operator is required to immediately correct the interference problem or cease operation.

4. In 1997, the Commission made available 300 megahertz of spectrum at 5.15-5.25 GHz (referred to hereinafter as U-NII-1), 5.25-5.35 GHz (referred to hereinafter as U-NII-2A), and 5.725-5.825 GHz (referred to hereinafter as U-NII-3) for use by a new category of unlicensed equipment, called U-NII devices which are regulated under part 15, Subpart E of the Commission's rules. In 2003, the Commission made an additional 255 megahertz of spectrum available in the 5.47-5.725 GHz (referred to

hereinafter as U-NII-2C) for U-NII devices. These actions align the frequency bands used by U-NII devices in the United States with the frequency bands used by U-NII devices in other parts of the world, thus decreasing development and manufacturing costs by allowing for the same products to be used in most parts of the world.

5. The U-NII-1 band is allocated on a primary basis to the Aeronautical Radionavigation Service for both Federal and non-Federal operations and on a primary basis for Fixed Satellite Service (Earth-to–space) for non-Federal operations. The U-NII-2A band is allocated on a primary basis to the Earth Exploration Satellite (active), Radiolocation, and Space Research (active) Services for Federal operation, and for non-Federal operation on a secondary basis.

6. The U-NII-2C band is allocated on a primary basis to the Radiolocation Service for Federal operation. The sub-band at 5.47-5.65 GHz band is allocated on a primary basis to the Radiolocation Service for non-Federal operation, and on a primary basis to the Maritime Radionavigation Service for both Federal and non-Federal operations. The 5.47-5.570 GHz band segment is allocated on a primary basis to the Earth Exploration-Satellite (active) and Space Research (active) Services for Federal operation and on the secondary basis for non-Federal operation. The 5.6-5.65 GHz band segment is allocated on a primary basis to the Meteorological Aids Service for both Federal and non-Federal operations. The band segment at 5.65-5.725 GHz is allocated on a secondary basis to the Amateur Radio Service for non-Federal operation.

7. The U-NII-3 band is allocated on a primary basis to the Radiolocation Service for Federal operation, and is allocated on a secondary basis to the Amateur Radio Service for non-Federal operation.

8. In early 2009, Federal Aviation Administration (FAA) reported interference to their Terminal Doppler Weather Radar (TDWR) that operates within the 5.60-5.65 GHz band. Early field studies performed by the National Telecommunications and Information Administration's (NTIA's) Institute for Telecommunications Sciences (ITS) and FAA staff indicated the interference sources were unlicensed U-NII devices that incorporated dynamic frequency selection (DFS), from different manufacturers, and operated in the same frequency band as these Federal radar systems.

9. The Commission brought together all of the principal parties including NTIA, FAA, industry participants and the FCC's Enforcement Bureau and Office of Engineering and Technology to analyze the interference situation. Based on these investigations, the Commission has taken actions to mitigate the interference situation, including issuing enforcement advisories to heighten users' awareness of TDWR interference issues, and the Office of Engineering and Technology has placed conditions on U-NII device certifications to curtail the interference risk. The Commission also has sent enforcement teams to work with FAA staff in the field, and has taken enforcement actions against operators of U-NII devices that caused interference to TDWR installations including issuing Letters of Inquiry and Notices of Apparent Liability for Forfeitures to operators found to be causing interference. Most of these interference cases were caused by devices not certified for operation in the U-NII-2C band, which includes the 5.6-5.65 GHz band used by the TDWRs. Instead, these devices had been certified for operation in the U-NII-3 band, either as U-NII devices under § 15.407 of the Commission's rules or as digitally modulated intentional radiators under § 15.247 of the Commission's rules, and which were operating at high power levels in elevated locations. The Commission's investigations found that most U-NII devices are manufactured to enable operation across a wide range of frequencies, extending down into the 4-GHz bands and up to almost 6 GHz. In many cases, the interference was caused by third parties modifying software configurations to enable operation in frequency bands other than those for which the device had been certified but without meeting the technical requirements for operation in those frequency bands. There was also an issue with devices that employed frame based architectures that allowed operators to reconfigure the talk/listen ratio of their devices.

10. In recent years, there has been an industry wide push to increase the amount of spectrum available for unlicensed use. In June 2010, the President issued an Executive Memorandum that encouraged the Commission to work closely with the Department of Commerce, through NTIA, to make available a total of 500 megahertz for commercial mobile and fixed wireless broadband use by the year 2020. The FCC's 2010 National Broadband Plan recommended that the Commission make available 500 megahertz of new spectrum for wireless broadband within 10 years. In analyzing the need for broadband

spectrum, the Commission also concluded that nearly 300 megahertz of spectrum is needed by 2014, and that making available additional spectrum for mobile broadband would create value in excess of $100 billion through avoidance of unnecessary costs.

11. In addition, Congress has enacted legislation that addresses unlicensed use of the 5 GHz band. The Spectrum Act requires the Commission to begin a proceeding to modify part 15 title 47, Code of Federal Regulations (CFR), to allow unlicensed U-NII devices to operate in the 5.35-5.47 GHz band (referred to hereinafter as U-NII-2B) no later than 1 year after the date of the enactment of the Act if, in consultation with the Assistant Secretary of Commerce (i.e., the NTIA Administrator), it determines that licensees will be protected by technical solutions and that the primary mission of Federal spectrum users in the band will not be compromised by the introduction of unlicensed devices in this band.

12. The Spectrum Act also requires NTIA, in consultation with the Department of Defense and other impacted agencies, to conduct a study evaluating known and proposed spectrum sharing technologies and the risks to Federal users if unlicensed U-NII devices were allowed to operate in the U-NII-2B band as well as in the 5.85-5.925 GHz band (referred to hereinafter as U-NII-4). NTIA was required to publish a report on the U-NII-2B band no later than 8 months after the date of enactment of the Spectrum Act and a report on the 5.85-5.925 GHz band (referred to hereinafter as U-NII-4) no later than 18 months after the date of enactment of the Spectrum Act. NTIA published a report (hereinafter referred to as "NTIA 5 GHz Report") on both the U-NII-2B and U-NII-4 bands on January 25, 2013.

Notice of Proposed Rulemaking

13. In the NPRM, the Commission took the first steps towards ensuring the U-NII bands continue to meet the demand for broadband spectrum, while ensuring protection of authorized operations, by proposing modifications to the part 15 rules. In particular, the Commission is proposing to align the provisions for operation of digitally modulated devices in the 5.725-5.85 GHz band, now permitted under § 15.247 of its rules, with the rules for the U-NII-3 band under § 15.407. This will expand the U-NII-3 band by 25 megahertz and provide consistent rules across 125 megahertz of spectrum. The Commission also seeks comment on aligning the power limits and permissible location for operations in the U-NII-1

and U-NII-2A bands to permit the introduction of a new generation of wireless devices in 200 megahertz of contiguous spectrum.

14. The Commission also addresses ways to ensure compliance with its rules across all of the U-NII bands and, in particular, the U-NII-2A and U-NII-2C bands to curtail interference to incumbent Federal operations (e.g. TDWR installations). The Commission seeks comment on various ways to prevent unlawful modification and operation of unlicensed devices in the U-NII bands as well as compliance issues that are likely to arise as the Commission moves toward wider bandwidth systems operating across multiple U-NII bands. Although some of the methods discussed would ensure that manufacturers and users comply with the Commission's requirements across any of the U-NII band segments, the Commission also seeks comment on some techniques that may be useful mainly in curtailing interference to incumbent Federal operations, such as Terminal Doppler Weather radar(TDWR) installations, in the U-NII-2A and U-NII-2C bands, such as geo-location and database registration, unwanted emissions limits, and guard band requirements. The Commission also seeks comment on several issues specific to the U-NII-2A and U-NII-2C bands regarding DFS functionality, the sensing threshold for co-channel operation, and revised DFS measurement procedures. The Commission asks that commenters address the benefits of adopting any of the proposals in the NPRM as well as the costs to do so, and that they weigh and compare the benefits and costs in each case. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

15. In the NPRM, the Commission also seeks comment on modifying part 15 Subpart E of the Commission's rules governing the operation of U-NII devices to make available an additional 195 megahertz of spectrum in the 5.350 – 5.470 GHz (U-NII-2B) and 5.850 – 5.925 GHz (U-NII-4) bands. This would increase the spectrum available to unlicensed devices in the 5 GHz band by nearly 35 percent and would represent a significant increase in spectrum available for unlicensed operations. Finally, The Commission seeks comment on transition periods for requiring compliance with any modified rules that the Commission ultimately adopts in this proceeding.

A. The Current U-NII Bands

1. Unlicensed Operations in the U-NII-3 Band

16. The Commission believes that now is an appropriate time to review its rules to eliminate the disparity and decrease the complexity associated with interpreting its rules for digitally modulated devices operating in the U-NII-3 band under § 15.407 and in the 5.725 – 5.85 GHz band under § 15.247 The Commission believes the changes proposed will ensure compliance with requirements designed to protect authorized services in the U-NII bands, simplify the Commission's authorization procedures, and reduce certification cost for manufacturers of these devices. The spectrum ecosystem has changed considerably since the Commission allowed the certification of "digitally modulated" devices. For example, the standards for wireless broadband devices are now capable of producing data rates in excess of 1 Gbits/s. In addition, devices are now able to utilize advances in antenna technology that allow the multiple data streams to be transmitted over multiple antennas. This provides an opportunity for the Commission to reflect on recent industry developments and propose new rules that have the potential to increase consistency in the process of certifying 5 GHz wireless broadband devices, while continuing to protect authorized services.

17. The Commission is proposing two changes that will eliminate the disparity in its rules for 5.7 GHz digitally modulated devices. First, the Commission proposes to extend the upper edge of the U-NII-3 band from 5.825 GHz to 5.85 GHz to match the amount of spectrum available for digitally modulated devices under § 15.247. The Commission believes that this change would eliminate the complexity and costs associated with multiple rule part certifications for these devices which are technically similar. Adopting this proposal would not increase the potential for harmful interference because this 25 megahertz segment is already available for devices certified under § 15.247. The Commission seeks comment on the potential benefits of expanding the U-NII-3 band to include an additional 25 megahertz of spectrum at the upper band edge. The Commission invites comment on whether there are cost advantages of this proposal. The Commission asks that commenter's assessment of adopting the proposal weigh and compare the benefits and costs to do so. This assessment should address

which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

18. Second, the Commission proposes to consolidate all equipment authorizations for digitally modulated devices in the 5.725-5.85 GHz band under the U-NII rules, while maintaining many of the technical rules that currently make equipment authorization under § 15.247 more attractive for equipment manufacturers. The Commission also proposes to remove the 5.725-5.85 GHz band for digital modulation devices from § 15.247. By doing this, the Commission will ensure that all digitally modulated equipment, which is technically similar, operates under a single rule part using identical technical rules. The Commission proposes to modify § 15.407 for digitally modulated devices and it seeks comment on all of these proposed rule changes. The Commission invites comment on the benefits of adopting any of the proposed rule changes below as well as the costs to do so. The Commission asks that commenter's assessment of adopting the proposals weigh and compare the benefits and costs to do so. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

19. Frequency Band. Section 15.247 allows operation throughout the 5.725-5.85 GHz band, while § 15.407 allows operation only in the 5.725-5.825 GHz band. The extra 25 megahertz of spectrum that is allowed under § 15.247 provides incentive for device manufacturers to certify devices under that rule rather than under § 15.407. The Commission proposes to expand the frequency band of operation in § 15.407 to include the 5.825-5.85 GHz band. This will allow U-NII-3 devices to operate across the full range of spectrum that can currently be accessed by digitally modulated devices under § 15.247.

20. Power. Section 15.247 allows 1 Watt of total peak conducted power (alternate measurement procedures are permitted), whereas § 15.407 limits maximum conducted output power to the lesser of 1 Watt or 17 dBm + 10 log B (in MHz, alternate measurement procedure in § 15.247 is required). In addition to the 1 watt power limit, there is a separate power spectral density (PSD) limit in both §§ 15.247 and 15.407 such that 1 Watt of total power is available only when the 6-dB bandwidth is 500 kilohertz or more under § 15.247 and when the 26-dB bandwidth is 20 megahertz or more under § 15.407.

Because the Commission is trying to accommodate digitally modulated devices that are currently permitted under both rules, the Commission proposes to remove the bandwidth dependent term (i.e., remove 17 + 10 log B) from § 15.407 so that the power limit will be 1 Watt. The Commission does not believe removing the variable power limit in § 15.407 would increase any potential for interference, because under current rules manufacturers are able to certify equipment that uses up to 1 Watt of power under § 15.247.

21. Power Spectral Density. Section 15.247 requires a maximum PSD of 8 dBm/3 kHz (33 dBm/MHz), whereas § 15.407 requires a maximum PSD of 17 dBm/MHz. The only difference between these two PSD limits is the bandwidth at which the 1 Watt total power, rather than the PSD, becomes the limiting factor. Specifically, § 15.247 allows a higher PSD when the device emission bandwidth is between 0.5 to 20 megahertz. Above 20 megahertz emission bandwidth, the 1 Watt power limit becomes the limiting parameter, and PSD is the same for both §§ 15.247 and 15.407. The Commission proposes to modify § 15.407 to require the PSD limit used in § 15.247 (i.e., 8 dBm/3 kHz (33 dBm/MHz)), so that digitally modulated devices designed to meet this limit will continue to comply with the new PSD requirement in § 15.407. This will ease the transition of all digitally modulated devices in the 5.725-5.85 GHz band to authorization and compliance under § 15.407. The only change for digitally modulated devices will occur when emission bandwidth is between 500 kilohertz and 20 megahertz. High-bandwidth devices like those typically used in U-NII applications will still be limited by 1 Watt total power, and thus the proposed change in PSD limits would not increase the risk of any potential interference. However, the Commission does realize that limiting the PSD to 8dBm/kHz (33dBm/MHz) would result in a PSD that is higher than the total power limit of 1 watt (30dBm). In addition, the Commission realizes that requiring devices that employ wider bandwidths to utilize a measurement bandwidth of 3 kHz may unnecessarily increase the time that it takes to complete measurement tests. The Commission seeks comment on whether it should increase the measurement bandwidth to 1 megahertz to reduce the complexity in measurement tests. The Commission notes that changing the measurement bandwidth would promote consistency within the U-NII rules. Should the Commission consider

implementing a different PSD limit and measure this limit across differing bandwidths, e.g. 500 kHz or 100 kHz measurement bandwidths?

22. Emission Bandwidth. Section 15.247 requires a minimum 6-dB bandwidth of 500 kilohertz. No minimum or maximum bandwidth is required under § 15.407, but the emission bandwidth is defined and measured as the 26-dB down points of the U-NII signal and is used to determine the total power allowed under that rule. Because the Commission is proposing to eliminate the bandwidth-dependent limit on total power, the Commission proposes to modify § 15.407 to eliminate the 26-dB bandwidth requirement and to add the minimum 6-dB bandwidth requirement from § 15.247.

23. Antenna Gain. Under § 15.247, the assumed antenna gain is 6 dBi, with a 1 dB reduction in power required for every 1 dB that the antenna gain exceeds 6 dBi. For fixed point-to-point systems, no power reduction is required. Section 15.407 assumes the same antenna gain of 6 dBi, with 1 dB reduction in power required for every 1 dB that gain exceeds 6 dBi. For fixed point-to-point systems, a 1 dB reduction in power is required for every 1 dB that gain exceeds 23 dBi. The only difference between the two rule parts is the maximum antenna gain that can be deployed without a penalty in transmitter power. The Commission proposes to apply the more stringent 23 dBi maximum antenna gain that is currently required under § 15.407. The Commission believes that using the more stringent antenna gain requirement will ensure that there is no increase in the potential for interference from unlicensed devices operating under the new combined rule parts.

24. Unwanted Emissions. Section 15.247(d) requires 20 dB of attenuation (30 dB if the alternate measurement procedure detailed in § 15.247(b)(3) is used). In restricted bands, emissions must meet the § 15.209 general emission limits. Section 15.407 requires unwanted emissions to be below -17 dBm/MHz within 10 megahertz of the band edge, and below -27 dBm/MHz beyond 10 megahertz of the band edge. Also, all emissions below 1 GHz must comply with the § 15.209 general emission limits. The unwanted emission limits in § 15.407 are somewhat more restrictive than those in § 15.247. Because unwanted emission can be reduced without affecting the utility of the device, and because using the more stringent unwanted emissions requirement will ensure that there is no increase in the potential for

interference from unlicensed devices operating under the new combined rule parts, the Commission is proposing that the more restrictive limits in § 15.407 be required for digitally modulated devices.

25. Peak to Average Ratio. Section 15.407 contains a requirement to maintain a peak-to-average ratio of no more than 13 dB across any 1 megahertz band, whereas § 15.247 does not contain any peak-to-average ratio requirement. The Commission believes that using the more stringent peak-to-average requirement will ensure that there is no increase in the potential for interference from unlicensed devices operating under the new combined rule parts, thus the Commission is proposing to keep the peak-to-average ratio requirement that is currently in § 15.407.

2. Unlicensed Operations in the U-NII-1 Band

26. The Commission adopted technical rules for the U-NII-1 band in 1997 that it believed would provide sufficient flexibility for the introduction of a variety of short-range communication devices within localized indoor settings. Although that vision was reasonable at the time, the Commission finds that today—over 15 years since those rules were adopted—the wireless device market has changed dramatically and the assumptions made in 1997 may not be valid for today's market. Unlicensed communication links are included in a wide variety of devices which are increasingly mobile or portable in nature, not easily limited to indoor locations, and often needing more power to link with other networks at farther locations.

27. At the same time, the Commission must protect incumbent authorized services, both Federal and non-Federal. A global network of satellite systems in non-geostationary satellite orbit (NGSO) in the mobile satellite service (MSS) operates feeder links in the U-NII-1 band. These NGSO/MSS feeder links require co-channel interference protection. The Commission also needs to consider the potential for interference to services in the bands immediately adjacent to the U-NII-1 band. Microwave landing systems operate below 5.15 GHz, and the Commission has proposed to add an allocation for Aeronautical Mobile Telemetry at 5.091-5.15 GHz.

28. The Commission seeks comment on whether the rules for the U-NII-1 band should be modified to harmonize with the rules for the U-NII-2A band in three areas. Specifically, the Commission

seeks comment on whether it should increase the power limits to those applicable in the U-NII-2A band, i.e., 250 mW with a maximum EIRP of 30 dBm with 6 dBi antenna gain. The Commission also invites comment on whether the rules for the U-NII-1 band should be modified to increase the PSD limits to those applicable in the U-NII-2A band, i.e., 11 dBm/MHz. Finally, the Commission seeks comment on whether the rules for the U-NII-1 band should be modified to eliminate the restriction on outdoor operation, and, if the Commission were to do so, whether it should allow outdoor operation only under the current power and PSD limits for the band or under the limits now permitted only in the U-NII-2 bands. The Commission believes that these changes would permit a new generation of wireless devices to be developed in the U-NII bands, particularly if industry develops wider bandwidth devices that would operate across multiple U-NII band segments. Harmonizing the power and use conditions across the lower 200 megahertz of U-NII spectrum would likely permit the introduction of a wide-range of new broadband products capable of operating at higher data rates than is now possible. The Commission seeks comment on these assumptions, and on the potential impacts to incumbent services, including any suggestions for mitigating interference.

29. The Commission also seek comment on whether the rules for the U-NII-1 band should be modified to harmonize with the rules for the U-NII-3 band to: (a) increase the power limits to 1 W with a maximum EIRP of 36 dBm with 6 dBi antenna gain; (b) increase the PSD limits to 17 dBm; and (c) limit out-of-band emissions to an EIRP of -27 dBm/MHz and (d) eliminate the restriction on outdoor operation. The Commission believes that these changes would permit for wider bandwidth devices that would not rely on contiguous spectrum under new Wi-Fi standards, and would permit the introduction of more outdoor access points for broadband use. The Commission seeks comment on these assumptions, and on the potential impacts to incumbent services, including any suggestions for mitigating interference.

30. The Commission invites comment on the benefits of adopting either of these approaches as well as the costs of doing so. The Commission asks that commenter's assessment of adopting either approach weigh and compare the benefits and costs to do so. This assessment should address which costs

should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

3. Ensuring Compliance with the Rules for the U-NII Bands

31. The Commission's Enforcement Bureau working cooperatively with the FAA has been successful in finding and resolving a large number of interference cases. In some cases, equipment that met the Commission's certification standards nonetheless caused interference, due to a variety of factors such as the configuration of the transmitter, its height and azimuth relative to the TDWR, and the device's failure to detect and avoid the radar signal. In many cases, however, the Commission staff found that the interfering devices were not certified or otherwise were not compliant with the Commission's rules. For example, the Commission found that devices that were certified as digital devices under § 15.247 for operation in the 5.725-5.850 GHz band had been unlawfully modified to transmit in the U-NII-2C band without demonstrating compliance with the DFS and TPC requirements for those bands. Typically, these modifications are made by operators of the devices, but manufacturers have produced equipment that is easily modified, especially through software changes, to permit devices to operate in non-compliant modes. The Enforcement Bureau is continuing to take action against companies for operating devices that cause interference to the TDWRs. The Commission notes that, while the TDWRs have been the focus of Commission investigations, DFS was designed to protect all incumbent radar operations and modification of devices as described poses a risk of interference to more than just TDWRs.

32. Interference studies conducted by NTIA and the FAA indicate that there may be some potential for interference from U-NII devices operating in frequencies occupied by or adjacent to radar systems. In its Third Technical Report regarding the interference into the TDWRs, NTIA explores frequency separations, distance separations, and maximum U-NII emissions limits needed to preclude harmful interference into the TDWR. The report analyzes the distances at which U-NII transmissions can be expected to routinely interfere with TDWR receivers. U-NII devices on rooftops, towers, and other high points that are 153 m to 305 m (500 to 1000 ft.) above ground level, as NTIA observed in San Juan,

PR, will interfere with a TDWR mainbeam at distances within 25 km to 41 km (16 mi to 25 mi), respectively, of a TDWR station. The report also specifies frequency separations necessary to protect TDWR from interference due to unwanted emissions from U-NII devices.

33. As a result of its ongoing discussions with NTIA, FAA and industry representatives, as well as the results of investigations conducted by the Commission, NTIA and FAA, and, the Office of Engineering and Technology has provided applicants for certification a representative way for demonstrating that their U-NII devices should not cause harmful interference to TDWR installations operating in the U-NII-2C band and accordingly can be authorized for manufacture and use. Specifically, OET has advised applicants that it will approve such devices upon assurance by the applicant that: (a) U-NII devices may not operate co-frequency with TDWR operations at 5.6-5.65 GHz; (b) grantee will provide owners, operators and installers of these devices with instructions that a master or client device within 35 km of a TDWR location must be separated by at least 30 megahertz (center-to-center) from the TDWR operating frequency and procedures for registering the devices in an industry-sponsored database; (c) the device does not include configuration controls to change the frequency of operation to any frequency other than those specified in the grant of certification; and (d) the device's software configurations do not allow for ad hoc networking, country code selection, or other mode of operation that would disable the DFS functionality of the U-NII device.

34. The interference cases the Commission has seen to date raise serious concerns with ensuring compliance with the Commission's rules in the U-NII-2C band, but there are other circumstances that also make this an opportune time for the Commission to consider compliance issues across the 5 GHz U-NII bands. For example, unlicensed wireless broadband device manufactures are now designing devices employing wider bandwidths (e.g., IEEE 802.11ac standard currently in development) using transmitters that are capable of operating across two or more U-NII bands. When devices are designed to operate across multiple frequency bands, the Commission's rules require that applicants demonstrate compliance with the rules for each of the individual frequency bands in which they intend to operate in order to be certified for operation in each band.

35. The Commission expects that more and more devices with even wider bandwidths will continue to be introduced in the 5 GHz band in the not too distant future as a result of new technical standards. The introduction of wider bandwidths under the IEEE 802.11ac standard presents complex issues for emissions testing to demonstrate compliance with the various requirements in the different U-NII bands. The Office of Engineering and Technology has published two guidance documents addressing these issues for testing of devices designed under this new standard as well as "pre-ac" devices, taking into account the current rules that permit authorization of digitally modulated devices under both §§ 15.407 and 15.247.

36. The Commission, NTIA, and the FAA have been working with manufacturers of U-NII devices and the WISPA to fully understand the causes of interference to TDWR systems and to identify ways to mitigate and significantly reduce the likelihood of interference. The Commission believes the rules proposed herein, in addition to continuing enforcement efforts, will enable us to achieve this goal while allowing U-NII devices to continue to operate successfully in the 5 GHz band.

37. Wireless networking devices that operate within the 5 GHz band typically have similar operational parameters, so that a device certified for operation in any one of the 5 GHz frequency bands, whether a U-NII band or not, can be easily tuned to another frequency band in the same spectrum range through software modifications. The Commission's experience with these devices shows that some of these devices are designed so that end-users can modify them to operate in bands for which they are not certified and thus do not meet the specific requirements intended to protect sensitive incumbent services. For example, in some recent interference cases investigated by the Commission's Enforcement Bureau, operators of devices certified under § 15.247 were tuned down into the U-NII-2C frequency band and operated with a higher gain antenna than what is permitted by the Commission's U-NII rules. The modification of devices in this manner resulted in both in-band and out-of-band emissions that were far in excess of what § 15.407 allows in the U-NII-2C band. Such unlawful modification and operation of these devices could considerably increase the distance at which these non-compliant devices cause harmful

interference to incumbent services. The Commission believes that its proposals, discussed to authorize all digitally modulated devices under identical rules in a modified § 15.407 will allow the Commission to more effectively and efficiently address interference risk to incumbent operations in the U-NII-2C and U-NII-3 bands.

38. The Commission believes that it should consider additional steps to further reduce the likelihood of interference not only to TDWR systems but to all other incumbent services in the 5 GHz bands as more composite and wideband devices are introduced across the 5 GHz band. The Commission recognizes that one of the difficulties in ensuring compliance with its current rules comes from the fact that these devices can easily be re-configured by operators modifying the software that controls the device's operational parameters, such as frequency band. This makes it difficult for the Commission not only to ensure compliance with its rules but also to enforce those rules.

39. Because the current and future use of the 5 GHz bands is heavily reliant on the successful implementation of the Commission's technical rules, the Commission proposes to require that manufacturers implement security features in any digitally modulated device capable of operating in the U-NII bands, so that third parties are not able to reprogram the devices to operate outside the parameters for which the device was certified. The Commission proposes and seeks comment on adopting this safeguard regardless of whether or how it modifies § 15.247 or §15.407. The Commission is particularly concerned that U-NII devices- which are not certified under the rules as software defined radios (SDRs) and thus may lack safeguards that are required for certified SDRs – may nevertheless be susceptible to manipulation by third parties who can modify the operating parameters of country code, frequency range, modulation type, maximum output power or the circumstances under which the transmitter has been approved. Specifically, the Commission seeks comment on whether it should require manufacturers to make it difficult for third parties to reprogram the embedded transmitter chip in certified devices. For example, should the Commission require that manufacturers ensure that modifying or reconfiguring firmware or software will make a device inoperable in certain bands? The Commission also seeks comment on whether it should require U-NII devices to transmit identifying information so that, in the

event interference to authorized users occurs, the Commission can identify the source of interference and its location. What type of information should be transmitted and in what format?

40. Although the Commission believes that requiring manufacturers to secure the software in their radios to prevent modifications by third parties provides a clear public benefit in ensuring that these devices comply with the rules as more devices are introduced and the number of users increases, the Commission recognizes that this requirement will add some cost to these devices. The Commission seeks comment on the proposals discussed, particularly information on the costs to manufacturers for implementing them. The Commission invites comment on the benefits of adopting these proposals as well as the costs to do so. The Commission asks that commenter's assessment of adopting the proposals weigh and compare the benefits and costs to do so. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

41. The Commission believes that its proposals to modify the technical rules in the U-NII-3 band, along with its proposal to enhance the security requirements of all U-NII devices, would have prevented most of the interference cases that the Commission has observed to date. The Commission also notes, however, that the NTIA Third Technical Report and its own discussions with NTIA, FAA and industry representatives have identified additional techniques that could mitigate in-band and adjacent band interference to incumbents. These include using a database registration process combined with geo-location technology to determine whether there is any potential interference to radar systems such as the TDWR; limiting the unwanted emission levels of the U-NII devices; or increasing the sensing frequency range (e.g., detection bandwidth) of U-NII devices operating in the U-NII-2A and U-NII-2C bands. These other techniques, could supplement or replace the assurances (described in paragraph 45 of the NPRM) that OET has accepted from certification applicants on an ad-hoc basis as sufficient to address interference concerns that might otherwise warrant denial of equipment certification requests for U-NII devices in the U-NII-2C band. The Commission also observes that these techniques would place responsibility on users, rather than on manufacturers, for mitigating interference. The Commission invites comment on whether the security requirements it is proposing to place on U-NII devices, along

with the more stringent unwanted emission limits that it is proposing for devices that would previously have been certified under § 15.247, are sufficient to protect incumbent radar operations, including TDWR installations, from interference, or whether the Commission should further modify its rules to require implementation of other techniques. In particular, the Commission seeks comment on the likely effectiveness of each technique discussed in reducing the incidence of interference to TDWR systems or other incumbent operations by ensuring compliance with and in facilitating enforcement of its rules. The Commission invites comment on whether any of these techniques would be beneficial in protecting other incumbents from interference, not only in the U-NII-2C band but also in other segments of the 5 GHz band. The Commission invites comment on the benefits of adopting any of the methods discussed as well as the costs to do so. The Commission asks that commenters' assessment of adopting any of the methods weigh and compare the benefits and costs to do so. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

42. Geo-Location/Database: The NTIA Third Technical Report specifies the frequency separations and distance separations needed to preclude interference from U-NII devices into the TDWR under the study conditions used for NTIA's investigation. The separation requirements differ for the various types of devices, but, in general, as the frequency separation increases the required separation distance between the U-NII devices and the TDWR decreases. For example, with main-beam coupling and ±30 megahertz of frequency separation from 20 megahertz-wide 802.11-based U-NII devices operating at an EIRP of 17 dBm, a TDWR needs a protection distance of 11 km. For 40 megahertz-wide 802.11 devices with a frequency separation of ±30 megahertz, the distance is 35 km; that distance is reduced to 15 km at a frequency separation of 50 megahertz above the center frequency and 10 km below the center frequency with a 50 megahertz frequency separation. As noted, the Office of Engineering and Technology has implemented these geographic and frequency separations as part of its equipment authorization program. Industry representatives have recommended to Commission staff that the Commission should implement these protections for high power point-to-point systems, and have argued that no additional limits or requirements are necessary for lower power, indoor systems. The

Commission seeks comment on whether it should require these geographic and frequency separations from TDWR and other Federal radars operating in the U-NII-2C band for high power outdoor U-NII devices authorized for operation in this band. How should the Commission define and distinguish outdoor versus indoor U-NII devices, or high power versus low power U-NII devices? How would the Commission enforce compliance with these distinctions?

43. One way to implement frequency and distance separation requirements is to require geo-location and database registration. Because the TDWR locations are known and somewhat limited in number, implementation of geo-location and database registration might be very straightforward and easy to accomplish. With this interference avoidance method, the location of an unlicensed device could be determined by a professional installer or by using geo-location technology such as GPS incorporated within the device. Using either of these methods, a user could determine from either an internal or external database whether the unlicensed device is located far enough from the TDWR to avoid causing harmful interference; if not, it could transmit on a frequency farther away from the TDWR's center frequency. CSMAC, for example, recommends implementing a Dynamic Database approach to device authorization. On a going-forward basis, devices and systems sharing a band would be "connected" devices and a geo-location/database approach could enforce permission and terms-of-use updates on an automated basis. The concept of database-enabled cognitive radios can lend itself to many applications, including ultimately sharing spectrum with Federal users. As noted, a voluntary database has been implemented by WISPA, which disseminates the location of TDWR to WISPs and encourages operators that install devices within 35 km or the line-of-sight of a TDWR, to operate at least 30 megahertz away from the TDWR operation frequencies. WISPA has also agreed to voluntarily provide a database where WISPs can register the locations of the outdoor transmitters that they use. The Commission seeks comment on whether, given the limited number of TDWR locations, a geo-location/database approach could be effectively implemented and maintained for numerous U-NII devices that would operate in the 5.6-5.65 GHz band. How will this approach protect other incumbent operations?

44. The Commission recognizes that its rules already require radar avoidance via the DFS mechanism. The Commission further recognizes that requiring the implementation of a database for TDWR could increase the complexity of U-NII devices if the Commission were to require that they include a geo-location capability. Alternatively, the Commission could modify its rules to specifically require professional installation and permit manufacturers to pass on this cost to the user of the device. In addition, a database for registering TDWR locations and, perhaps, U-NII device users and locations as well would entail some cost to establish and maintain. The Commission seeks comment on what the cost would be to implement geo-location/database protection, what the requirements should be, and how to define "professional installation." The Commission also seeks comment on whether requiring the implementation of both DFS and geo-location interference protection mechanisms would be overly burdensome for equipment manufacturers and whether it is necessary to require both. Are there alternative approaches that can be implemented to protect the incumbent radar systems? Because higher power outdoor devices (such as those used by Wireless Internet Service Providers) in the U-NII-2C band have a greater potential to cause harmful inference as compared to lower power consumer type devices, the Commission requests comment on whether a geo-location/database requirement should apply only to those devices or to lower power indoor U-NII devices as well.

45. Unwanted emission limits. Emissions outside of the U-NII device's occupied bandwidth may have the potential to cause harmful interference into TDWR. Aside from increasing frequency separation or distance separation, U-NII devices may avoid causing interference by lowering the emissions on the radar's fundamental frequency. This equates to lowering all emissions from U-NII devices at the frequencies outside of the device's operating bandwidth. The Commission seeks comment as to whether TPC also contributes to reductions in unwanted emissions. For example, if the TPC function reduces the fundamental power level by 1 dB, is there a corresponding 1 dB reduction in unwanted emissions?

46. NTIA's report details the measurements and analysis that determine the power levels at which TDWR receivers experience interference from U-NII emissions at an interference-to-noise (I/N)

ratio of -8 dB. In its report, NTIA finds that the maximum allowable co-channel interference power that can be received in the TDWR without exceeding the I/N level of -8 dB is shown to be -119 dBm/MHz at the antenna terminals. This equates, for example, to a mainbeam-to-mainbeam interference power density of 43 dBm/MHz between TDWR and U-NII transmitters at a distance of 8 km, or an interference power density of -22 dBm/MHz when the mainbeam of the U-NII device is in the TDWR sidelobe at a distance of 2 km. These power density thresholds are a function of separation distance between TDWR receivers and U-NII transmitters as well as the receive antenna gain of the TDWR in the direction of the U-NII transmitter.

47. The Commission's existing rules for the U-NII-2C band specify that the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density must be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. These rules implicitly allow a maximum EIRP of 17 dBm/MHz in the U-NII-2C band. Additionally, for devices operating within the U-NII-2C band, the Commission's rules specify that all emissions transmitted outside of the U-NII-2C band shall not exceed an EIRP of -27 dBm/ MHz. The Commission recognizes, based on NTIA's report, that these two limits may not be sufficient to protect the TDWR from adjacent channel emissions from U-NII devices. Accordingly, the Commission seeks comment on whether requiring new unwanted emission limits for U-NII devices operating in the U-NII-2A and UNII-2C bands is appropriate and whether the Commission should modify its emission limits to reflect NTIA's findings.

48. If the Commission were to impose new limits on U-NII devices, as suggested, the Commission believes that different limits can be set for lower power indoor and higher power outdoor devices. For indoor devices, the Commission believes that setting an out-of-channel emissions limit of -27dBm/MHz maximum EIRP may be appropriate because building materials would likely further attenuate these emissions. When measured outside of the building, the emissions from an indoor device would likely drop to a level that would appear as no more than -41dbm/ MHz. An out-of-channel

emissions limit of -41 dBm/MHz for outdoor devices may be appropriate as well. The Commission seeks comment on modifying its rules to adopt these out-of-channel limits for indoor versus outdoor U-NII devices, including how the Commission should define the terms "indoor" and "outdoor", and how different operating requirements for indoor versus outdoor operations can be accommodated through the Commission's equipment authorization and the Commission's enforcement procedures.

49. As an alternative, if the Commission determines that reductions in unwanted emissions are necessary, the Commission could allow outdoor devices to operate with an out-of-channel emissions limit of -27 dBm/MHz peak EIRP as long as the separation distance between the device and the TDWR is at least 53 km. Should the Commission impose this new out-of-channel limit based on the maximum power levels of the devices rather than whether a device is based indoor or outdoor? For instance, the Commission recognizes that lower power device devices provide short-range communications, such as those between computing devices within a very local area and therefore pose less of a potential risk to TDWR operations. Higher power devices, however, are intended to be used in an outdoor environment for longer-range communications. The Commission seeks comment on the assumptions made in its analysis.

50. Sensing. If the Commission decides to require that a U-NII device move more than 30 megahertz in frequency from the TDWR, one way to enable this is to require the U-NII device to sense for radar in the channels adjacent to its occupied bandwidth. This will ensure that the unwanted emissions from U-NII devices are placed far enough away in frequency from the TDWR fundamental frequency to preclude harmful interference. The Commission seeks comment on this alternative approach.

51. The DFS mechanism is designed to avoid co-channel interference to the TDWR by dynamically detecting radar signals and avoiding co-channel operation with those systems. The efficacy of the DFS mechanism is dependent upon the U-NII device's ability to detect and avoid a radar pulse within a region of its occupied bandwidth. Specifically, the current measurement procedures require that a U-NII device sense for radar across 80 percent of its occupied bandwidth. With respect to the

remaining 20 percent, the Commission does not require sensing in a 10 percent region above or below the occupied bandwidth. The Commission recognizes that currently implementation of the sensing bandwidth will ensure co-channel interference protection only when the radar signal falls within 80 percent of the U-NII device's occupied bandwidth. Therefore, it is possible for the U-NII device to transmit on the same frequency as the radar when the radar signal falls within the 20 percent of occupied bandwidth that does not require sensing. When the radar signal falls within the region of occupied bandwidth that does not require sensing, the U-NII device will continue to transmit. This could result in simultaneous and overlapping transmissions from the U-NII device and the TDWR, which would increase the potential for harmful interference.

52. In addition, NTIA's Third Technical Report suggests that adjacent channel interference is possible when the frequency separation between the radar and the U-NII device is less than a specified amount. For example, when a radar signal falls outside of the sensing bandwidth and occupied bandwidth, and is within 30 megahertz from the U-NII devices' fundamental frequency, the unwanted emissions from the U-NII devices could still cause harmful interference to the TDWR. If the Commission requires that U-NII devices sense for radar on the frequencies immediately adjacent to the occupied bandwidth, the Commission would ensure that the fundamental frequency is more than 30 megahertz away from the radar.

53. The Commission seeks comment on whether it should implement a rule requiring that U-NII devices sense for radar signals at or exceeding 100 percent of its occupied bandwidth, or whether the Commission should continue to reference this, as it does now, as part of the U-NII measurement procedures. The Commission believes that expanding the sensing bandwidth will prevent the co-channel operations between U-NII devices and radars receiver and thus will reduce the potential for harmful interference. The Commission also invites comment on the technical difficulty and cost of implementing this capability in U-NII devices.

4. The U-NII-2A and U-NII-2C Bands

54. DFS is an essential element allowing U-NII devices to share the U-NII-2A and U-NII-2C

bands successfully with vital government and military radar systems. As the Commission has gained experience with these devices and the implementation of DFS in the field, it is proposing changes in three areas to improve the utility and reliability of this function, thus ensuring that incumbent services in these bands are protected from interference. These changes include lowering the permitted PSD for lower power devices that use the relaxed sensing threshold, and modifying the Bin-1 radar simulating waveform used in the measurement procedures. The Commission believes that these changes will reduce the potential for co-channel interference to the TDWR and other radar systems. The Commission is also proposing to remove the uniform channel loading requirement found in the U-NII measurement procedures.

55. DFS Functionality. To be certified for operation in the U-NII-2A and U-NII-2C bands, devices must include a DFS radar detection function. In its field investigations, the Commission's Enforcement Bureau found that certain models of devices certified for use in these bands were designed so that users could disable the DFS mechanism by setting the device's operating mode to "Compliance test." In other cases, the device's DFS mechanism could be turned off by manually changing the "Country Code" for the device. If the DFS mechanism is not active, the device could transmit on an active radar channel and cause harmful interference. The Commission therefore proposes that manufacturers prevent the DFS mechanism from being disabled in devices certified to operate in the U-NII-2A and U-NII-2C bands. The Commission also proposes that U-NII devices certified to operate in these bands must be operated with the DFS function on.

56. Recently, the Office of Engineering and Technology has had to clarify which types of U-NII devices are required to demonstrate compliance with the DFS requirement. The Commission knows that many U-NII devices operate in a master-client configuration, i.e., the master device controls the operational parameters of the client devices. Typically, DFS-enabled master devices would include both the radar sensing and DFS functions, but new configurations are being designed. For example, radios can operate in a network configuration with the sensing function distributed among various "client" devices. Also, some radios are designed so that they can communicate directly with each other, rather than through

a control point, and thus they could function as either a "master" that initiates a network or as a "client" device within the network. The Commission proposes that any U-NII device that is subject to the DFS requirements in § 15.407 that is capable of initiating a network must have radar detection functionality and must be approved with that capability.

57. The Commission believes that responsible operation of U-NII devices in these bands is a joint responsibility of both manufacturers and users. The Commission seeks comment on these proposals regarding DFS functionality as well as information on costs to implement them. The Commission also invites comment on whether the DFS requirement has limited in any way the types of applications that have been or could be implemented in the U-NII-2A and U-NII-2C bands, particularly if wider bandwidth devices are deployed in this spectrum. The Commission invites comment on the benefits of adopting this proposal as well as the costs to do so. The Commission asks that commenters' assessments of adopting the proposal weigh and compare the benefits and costs to doing so. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

58. Sensing Threshold for Co-channel operation: The current rules require that the DFS mechanism continuously monitor the device's environment for the presence of radar, both prior to and during operation. The Commission further requires that U-NII devices certified under the rules use two detection thresholds to ascertain whether radar signals were present. The required threshold levels are: (a) 62 dBm for lower power devices with a maximum EIRP less than 200 mW (23 dBm), and (b) -64 dBm for higher power devices with a maximum EIRP between 200 mW (23 dBm) and 1 W (30 dBm), averaged over 1 μs. The Commission also requires that the conducted peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, the Commission requires that both the maximum conducted output power and the power spectral density be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. Thus, the implicit limit on the EIRP spectral density is 17 dBm in any 1 megahertz band.

59. The lower power U-NII devices are permitted to use the relaxed sensing threshold because the range at which these devices can potentially cause interference is reduced and thus they are allowed to operate closer to the radar. In order to ensure that interference potential does not increase with the use of the relaxed sensing threshold, the Commission believes that applying a reduction in EIRP spectral density for devices that use the -62 dBm sensing threshold is appropriate. The Commission proposes that devices must operate with both an EIRP of less than 200 mW (23 dBm), and an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz), in order to use the relaxed sensing detection threshold of -62 dBm. Devices that do not meet the proposed EIRP and EIRP spectral density requirements must use the -64 dBm sensing threshold. The proposed changes will further enhance protection for radars from co-channel interference by reducing both the range and the in-band spectral density emissions of the U NII device. The Commission seeks comment on this proposal, including the cost to manufacturers to implement it. The Commission notes that a reduction in the EIRP spectral density limit would be consistent with recent actions taken by European Telecommunications Standards Institute (ETSI). Specifically, ETSI chose to restrict a device's use of the relaxed sensing threshold by reducing both the EIRP and the EIRP spectral density by 7 dB to 23 dBm (200 mW) and 10 dBm/MHz (10 mW/MHz), respectively. The Commission invites comment on the benefits of adopting this proposal as well as the costs to do so. The Commission asks that commenter's assessment of adopting the proposal weigh and compare the benefits and costs to do so. This assessment should address which costs should be borne by U-NII device manufacturers, U-NII device operators or other third parties, as appropriate.

60. Measurement and Testing Procedures. Under § 2.947(a) of the rules, the Commission will accept data that is measured in accordance with (1) procedures or standards set forth in bulletins or reports prepared by the Commission's Office of Engineering and Technology (OET), (2) procedures or standards that are acceptable to the Commission and are published by a national engineering society, or (3) any other measurement procedure acceptable to the Commission. With respect to the first option, OET's most recent bulletin on measurement procedures for U-NII devices with DFS capabilities was published in 2006. NTIA has recommended modifications to these 2006 measurement procedures, to

further enhance protection for the TDWR. The Commission invites interested parties to comment on these modifications to the measurement procedures, which are set forth in Appendix B of the NPRM, and to propose any additional modifications that are appropriate. Consistent with the Commission's rules and prior practice, the Office of Engineering and Technology will evaluate comments on the recommended changes to the measurement procedures and will issue updated measurement procedures in the future as needed.

61. The Commission's current rules and measurement procedures require that the DFS function provide a uniform spreading of loading over all available channels. The measurement procedure further explains this provision by stating that "Uniform Channel Spreading" is the spreading of U-NII devices operating over the DFS bands to avoid dense clusters of devices operating on the same channel. Some manufacturers comply with this requirement by using random channel selection, but the Commission believes that similar benefits could be obtained by manual selection of channels and may actually result in better spectrum usage at a given location. In particular, the Commission notes that enhanced spectrum use may be possible when devices use a very high bandwidth and the number of usable channels is small. The Commission also notes that the trend for U-NII devices is to operate with ever wider bandwidths. Operation over wider bandwidths causes U-NII energy to be spread throughout the frequency band in which the device is operating, rather than concentrated in a narrow bandwidth. This potentially makes the uniform channel spreading requirement unnecessary. The Commission proposes to remove the "Uniform Channel Spreading" requirement from the rules and measurement procedures. The Commission also proposes to permit either random channel selection or manual selection of the initial channel. For example, should the Commission permit a device to create a master list of available channels that it would use if they continue to be available? The Commission seeks comment on whether these changes will, in any way, negatively impact spectrum reuse or potentially increase interference to incumbent users. In addition, the Commission's measurement procedures require that system testing be performed with an MPEG test file that streams full motion video at 30 frames per second for channel loading. Experience certifying U-NII devices has indicated that not all U-NII devices are designed for video transmission or

support the specific coding format, and so other methods of channel loading are used. The Commission seeks comment on whether specifying video streaming as the preferred channel loading method for compliance measurements is as appropriate today as it was when the measurement procedures were created, or whether the channel loading requirement in the Commission's test procedures should be specified in a more general manner so as only to specify that measurements be conducted with the device under test operating in a loaded condition. The Commission seeks comments on how it should specify alternate means of channel loading for measurement purposes. Additionally, the Commission seeks comment on the effects of wider U-NII device bandwidths on channel loading requirements.

B. Future Unlicensed Operations at 5 GHz

62. The 5.35 – 5.47 GHz (U-NII-2B) and 5.85 – 5.925 GHz (U-NII-4) bands have great potential for fostering ongoing technological innovation, expanding broadband access, and encouraging competitive entry. The additional spectrum also would expand opportunities for innovative spectrum access models by creating new avenues for opportunistic and unlicensed use of spectrum and increasing research into new spectrum technologies. Creating ways to access spectrum under a variety of new models, including unlicensed uses, increases opportunity for entrepreneurs and other new market entrants to develop wireless innovations that may not have otherwise been possible under licensed spectrum models.

63. These bands currently are used for various Federal and non-Federal services, and the Spectrum Act requires that the Commission begin a proceeding to modify the part 15 rules to permit unlicensed devices in the U-NII-2B band if, in consultation with NTIA, it determines that licensed users will be protected by technical solutions and that the primary mission of Federal spectrum users will not be compromised by the introduction of unlicensed devices in these bands. Thus, the Commission's goal in this proceeding is to promote efficient use of radio spectrum through spectrum sharing. As part of this collaborative effort and as required by the Spectrum Act, NTIA has published a report, prepared in consultation with Department of Defense and other impacted Federal agencies, evaluating spectrum-

sharing technologies and the risk to Federal users of unlicensed operations in the U-NII-2B and U-NII-4 bands.

64. The Commission explores the potential for future unlicensed operations in the 5 GHz band, incumbent operations in the U-NII-2B and U-NII-4 bands, and the technical requirements and sharing technologies and techniques that could be used to protect Federal and non-Federal incumbent operations. The Commission also invites comments on the NTIA 5 GHz Report itself, including its underlying assumptions and risk assessments.

1. Future Unlicensed Operations at 5 GHz

65. The current U-NII bands are already being used for a variety of different commercial uses such as wireless internet services, cordless phone, scientific and medical applications, etc. In this proceeding, the Commission seeks comment on what types of uses could be deployed in the U-NII-2B and U-NII-4 bands, used either independently of the current U-NII bands or in conjunction with them. The Commission is interested in knowing how companies of different types might deploy U-NII devices, what types of services they might offer, and where they might deploy them. The Commission is particularly interested in gathering information on ongoing industry standards activity and international efforts to harmonize uses of the 5 GHz band to make more efficient use of the 5 GHz spectrum.

66. The Commission knows, for example, that unlicensed and licensed broadband networks often complement one another in important ways. The availability of unlicensed Wi-Fi networks in many locations enables licensed wireless providers to take data traffic off of their networks, thus reducing network congestion and delivering a better overall quality of service. Wi-Fi technology also can be "networked" to provide wider geographic coverage and, when configured this way, may be used by some service providers in offering broadband service.

67. The introduction of the IEEE 802.11ac standard, can open new windows to wireless broadband for many users. The deployment of wide channel bandwidths with higher data rates in the 5 GHz band can help meet the challenge that rapid growth in demand has posed for the wireless industry which has called for more spectrum to increase network capacity. The new standard has the potential to

create new avenues for opportunistic use of spectrum in diverse broadband services. Some forecasts predict that in 2015, shipments of mobile phones with embedded Wi-Fi are projected to approach 800 million and by the same time 100 percent of mobile hotspot shipments will be 802.11ac enabled. Infonetics forecasts the global carrier Wi-Fi equipment market to grow significantly at least through 2016, when it will hit $2.1 billion. The Commission seeks comment on how the introduction of this new standard might be implemented in the U NII bands and how these developments should inform the Commission's consideration of technical requirements for these bands and sharing technologies and techniques. The Commission also invites comment on whether some technologies or techniques, such as DFS, might limit the types of applications that could be implemented in the U-NII bands, particularly if wider bandwidth devices are deployed in this spectrum.

68. Also, at the 2012 World Radio Conference, the United States along with other countries agreed that the next World Radio Conference in 2015 (WRC-15) should consider additional spectrum allocations to the mobile service for the development of terrestrial mobile broadband applications. In preparation for WRC-15, the International Telecommunications Union initiated spectrum sharing studies that consider possible expansion of the existing international allocations to the mobile services in the 5 GHz band which are used primarily by the radio local area network (RLAN) devices. The Commission seeks comment on how these activities should inform the Commission's consideration of technical requirements for these bands and sharing technologies and techniques in the following paragraphs. The Commission also seeks comment on importance and benefits of harmonization between the Commission's U-NII rules and the international radio regulations.

2. Incumbent Services in the U-NII-2B Band

69. The 5.35 – 5.47 GHz band is allocated on a primary basis to the Earth Exploration Satellite, Space Research, and Radiolocation Services for Federal operations and on a secondary basis for non-Federal operations. The 5.35-5.46 GHz band segment is allocated on a primary basis to the Aeronautical Radionavigation Service for both Federal and non-Federal operations. The 5.46-5.47 GHz band segment

is allocated on a primary basis to the Radionavigation Service for both Federal and non-Federal operations.

a. Overview of Federal Systems

70. RADAR Systems. The DoD uses the 5.35-5.47 GHz band for a wide variety of ground-based, shipborne, and airborne radars. These military radars have the operational capability to tune across the entire 5.25-5.725 GHz frequency range and can operate on a fixed frequency or can employ frequency hopping techniques. In the past, these radars have operated on or near military installations. However, situations may arise where these radars have to be used more widely in support of homeland security. One of the areas of concern in assessing interference to military radars stems from future radar deployments and the expanding role of military radars in support of homeland defense. This expanded role could result in a requirement to deploy military radars in cities and metropolitan areas where unlicensed devices will have their highest usage. In addition to DoD, several other agencies operate radar systems in the band. The Coast Guard operates shipborne radars, which are vital sensors for safe navigation of waterways. NASA uses this band for test and launch range instrumentation radars to track rockets, missiles, satellites, launch vehicles, and other targets. NOAA operates radar systems in this band on "Hurricane Hunter" aircraft. The Department of Energy operates radar systems and associated transponders in the band at two test ranges in the United States.

71. Spaceborne Altimeter Radar Systems. NASA, in joint ventures with the French agency, Centre National d'Etudes Spatiales (CNES), operates a space-based altimeter system in the 5.14-5.46 GHz band that is used to obtain measurements of the Earth's ocean surface height.

72. Earth Exploration Satellite. Synthetic aperture radar (SAR) systems in the 5.35-5.47 GHz band perform space-based observations and measurements of surface topography, soil moisture, and sea surface height. The higher quality data collected using wideband SARs allow scientists to gain new insights into the prediction of climatic changes. These wideband SARs also provide the higher resolution necessary for commercial applications, such as high-resolution surface mapping. Canada operates an Earth exploration-satellite, known as RADARSAT, in the 5.35-5.47 GHz band to provide mission critical

data in support of national security, public safety, law enforcement, and civilian applications in Canada and the United States. These applications include disaster management, response and recovery for safety of life, ice monitoring, surveillance, hydrology, mapping, and geology, safety of navigation, agriculture, and forestry. For example, the United States Coast Guard International Ice Patrol uses RADARSAT data operationally to detect and track icebergs.

73. Unmanned aircraft systems (UAS). DoD utilizes this band for the testing and operation of unmanned aircraft system (UAS) datalinks from aircraft-to-ground and from ground-to-aircraft. The command link, a ground data terminal transmitter, operates at 5.625-5.85 GHz and the return link (UAS transmitter) transmits at 5.25-5.475 GHz. The Army, Navy, and Air Force operate UASs in the 5 GHz frequency range for intelligence, surveillance, and reconnaissance; combat search and rescue; and real-time full-motion video for target development. The Department of Homeland Security also operates UASs in this band for drug interdiction and border surveillance operations. In addition, NASA also operates a limited number of systems in the 5.35-5.47 GHz band that are used for downlink transmissions of data to ground control receivers.

b. Overview of Non-Federal Systems

74. The types of Federal and non-Federal systems in the 5.35-5.47 GHz band are similar except that non-Federal users in the Earth Exploration Satellite, Space Research, and Radiolocation Services operate on a secondary basis. Broadcast and media entities use radars operating in the 5.35-5.47 GHz band for tracking storms and providing weather radar information to the public via news and weather reporting. Weather radars are employed by broadcasters throughout the USA and used to detect supercell storms capable of developing tornados and severe weather. Local TV stations throughout the country utilize 5.35-5.47 GHz band providing viewers with weather maps, weather pictures, and informing the public on a range of local and regional weather warnings. Part 90 of FCC rules permit the operation of weather radar services in the 5.35-5.47 GHz band.

3. Incumbent Services in the U-NII-4 Band

75. The 5.85 – 5.925 GHz band is allocated on a primary basis to the Radiolocation Service for

Federal operations and to the Fixed Satellite (Earth to space) and Mobile Services for non-Federal operations. This band is also allocated on a secondary basis to the Amateur Service for non-Federal operations.

a. Overview of Federal Systems

76. The radars that operate in the 5.825-5.925 GHz band are primarily military surveillance and test range instrumentation systems and can be either mobile or transportable. In addition to the DoD operation, NASA, NOAA, and Department of Energy operate radar systems in the 5.85-5.925 GHz band throughout the United States.

b. Overview of Non-Federal Systems

77. Fixed Satellite Services (FSS). The C-band is divided into a heavily-used "conventional" segment (3.7-4.2 GHz downlink and 5.925-6.425 GHz uplink) and a lightly-used "extended" segment (3.6-3.7 GHz downlink and 5.85-5.925 GHz and 6.425-7.075 GHz uplink). The non-Federal fixed-satellite service allocation in the extended C-band FSS (5.85-5.925 GHz) is limited to international inter-continental systems and is subject to case-by-case electromagnetic compatibility analysis. Earth stations in stationary locations communicate uplink with geostationary satellites such as Intelsat, Inmarsat, JCSAT-2, Mabuhay, New Skies, and Galaxy. The earth stations and satellites use directional antennas which, along with the separation between the satellites, prevent interference with earth stations communicating with adjacent satellites. The FSS operations in the 5.85-5.925 GHz band are authorized under Part 25 of the FCC rules.

78. The FSS is widely used to provide a variety of commercial services domestically and internationally. For example, the FSS supports video distribution both on point-to-point basis and point-to-multipoint bases. The FSS also provides network services consisting of "backbone" capacity for point-to-point trunking for voice, data or Internet traffic; backhaul of communications services; and redundancy and restoration of communications services when other primary technologies fail. Further, the FSS is used to provide corporate, government, and military voice and data communications, as well as broadband and video services directly to the home.

79. Intelligent Transportation Service (ITS). The non-Federal Mobile allocation is limited to Dedicated Short Range Communications Service (DSRC) systems operating in the Intelligent Transportation System radio service. ITS is a national program aimed at using state-of-the-art communications system to make travel more efficient, safer and convenient for motorists, transit riders, commercial vehicle operators and public safety providers. Through the use of technologies such as roadside and/or overhead Variable Message Signs, Closed Circuit TV, Highway Advisory Radio transmitters, traffic counter loops and Transcom's System for Managing Incidents and traffic flow monitors, real-time traffic information is collected and conveyed to the traveling public. This multi-modal information then allows motorists to make smarter choices about how, when and where to travel.

80. DSRC is a wireless ITS system designed for automotive use. In October 1999, the FCC allocated 75 megahertz of spectrum in the 5.85-5.925GHz band for DSRC to be used by ITS. DSRC is a two-way short- to- medium-range wireless communications capability that permits very high data transmission critical in communications-based active safety applications. DSRC which involves vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications can save lives by warning drivers of an impending dangerous condition or event in time to take corrective or evasive actions. Vehicle safety applications that use V2V and V2I communications need secure, wireless interface dependability in extreme weather conditions, and short time delays; all of which are facilitated by DSRC. FCC grants licenses for state and regional transportation agencies to operate DSRC roadside units, while DSRC onboard units are licensed by rule under Part 95.

81. Amateur Radio. Amateur service stations are permitted to transmit in the 5.85-5.925 GHz frequency segment on a secondary basis. Operation of these stations in this frequency segment must not cause harmful interference to, and must accept interference from, authorized stations in the fixed-satellite (earth to space) and mobile services (DSRC) and also stations authorized by other nations in the fixed service. The FCC does not have detailed information on use of this band by amateur service stations.

4. Technical Requirements for U-NII-2B and U-NII-4 Bands

82. The technical requirements for U-NII devices operating in the U-NII-2B and U-NII-4 bands

will depend ultimately on a determination of the types of unlicensed operations that can be supported while maintaining interference protection to incumbent Federal and non-Federal users. Nonetheless, the Commission believes that because the types of incumbent services across the 5 GHz spectrum share similar characteristics, the technical requirements for unlicensed devices also could share similar characteristics.

83. U-NII-2B Band. The U-NII-2B band falls between the existing U-NII-2A and U-NII-2C bands. Most significantly, all three bands are allocated for Federal Earth Exploration Satellite, Space Research and Radiolcoation Services on a primary basis, and sensitive services such as Federal radar systems operate across all three bands. This suggests that U-NII devices could likely operate under the same technical framework specified in rule § 15.407 in all three bands ranging from 5.25 – 5.725 GHz. Thus, U-NII devices could operate across 475 megahertz either indoors or outdoors under the following power and emission limits: maximum output power limit is the lesser of 250 milliwatts and 11dBm+10 Log (B), where B is 26 dB emission bandwidth; antenna gain requirement is 6 dBi for non-point to-point systems and 23 dBi for point-to-point system; and power and power spectral density reduction is applied if the antenna gain exceeds these values. The maximum power spectral density should not exceed 11 dBm in any 1 megahertz band, and the out-of-band emission limit shall not exceed an EIRP limit of -27 dBm/MHz. The out-of-channel emissions limit for an outdoors device should not exceed -41 dBm/MHz. The Commission invites comment on these technical parameters for U-NII-2B devices.

84. U-NII-4 Band. The U-NII-4 band is situated 25 megahertz above the U-NII-3 band. A primary Federal allocation for Radiolocation Services and a non-Federal secondary allocation for Amateur Services range across the U-NII-3 and U-NII-4 bands, including the 25 megahertz located between them at 5.825-5.85 GHz. This suggests that U-NII devices should operate under the same framework and technical requirements specified in § 15.407 in all three bands ranging from 5.725 – 5.925 GHz. The Commission proposes that the U-NII-3 rules be applied to the upper adjacent 25 megahertz band segment at 5.825-5.85 GHz. If the Commission adopts this proposal, it believes that the same framework and technical requirements specified in § 15.407 should apply across the expanded U-NII-3

and the U-NII-4 bands. Thus, U-NII devices could operate across 200 megahertz either indoors or outdoors under the following power and emission limits: maximum output power limit is the lesser of 1Watt and 17dBm+10 Log (B) where B is 26 dB emission bandwidth; antenna gain requirements is 6 dBi for non-point to-point systems and 23 dBi for point-to-point systems; and power and power spectral density reduction is applied if the antenna gain exceeds these values. The maximum power spectral density should not exceed 17 dBm in any 1 megahertz band, and out-of-band emissions within the frequency range from the band edge to 10 megahertz above or below the band edge should not exceed an EIRP limit of -17 dBm/MHz, and for frequencies 10 megahertz or greater, the emissions should not exceed an EIRP of -27 dBm/MHz. The Commission invites comment on these technical parameters for U-NII-4 devices.

85. Spectrum Sensing/DFS and TPC. The rules require that U-NII devices operating in the U NII-2A and U-NII-2C bands employ Dynamic Frequency Selection (DFS) in order to avoid causing interference to Federal radar systems. The Commission seeks comment whether and how to integrate a DFS algorithm into U-NII-2B and U-NII-4 bands. What are the advantages and/or disadvantages of utilizing DFS in these bands? What are the technical challenges of DFS technology implementation in the U-NII-2B and U-NII-4 bands? What changes are necessary in the existing DFS model to mitigate possible interference with incumbent radar system in the new bands? What radar parameters/signal detection threshold should be used for DFS to avoid assigning the occupied radar channel to U-NII device? If the U-NII device would have to perform sensing outside its occupied bandwidth (adjacent channel sensing), what would be the technical and cost implications of such deployment? Should the radar signal detection be sensed by base/fix stations, mobile stations or all? Are there technical solutions other than DFS that would prevent interference to Federal radar systems? Could database access offer any benefits for providing access to this spectrum while protecting incumbent services against harmful interference?

86. The signal detection technology currently used by U-NII-2A and U-NII-2C DFS devices senses radar signals whose parameters (such as pulsewidth, pulse repetition interval, and the number of

pulses per burst) are well-known and can be used to improve signal detection. To improve range resolution and accuracy, some radar systems operating in the U-NII-2B and U-NII-4 bands employ short (sub-microsecond) pulse widths. The smallest pulsewidth used in the development of the existing U-NII DFS regulations was 1 microsecond. A narrower radar pulsewidth used in conjunction with the higher data rates associated with the 802.11ac standard could affect a device's ability to detect pulsed radar signals. The Commission seeks comment on the ability of signal sensing spectrum-sharing technologies to detect sub-microsecond pulses and whether the current DFS mechanism would protect the current and future radars that employ sub-microsecond pulses. Are there other detection mechanisms that could be considered?

87. In addition, some fielded and in-development radar systems in the U-NII-2B and U-NII-4 bands include low-power modes or are designed to avoid detection to meet their mission requirements. The Commission seeks comment on whether DFS or any other spectrum-sharing technology would be capable of protecting such radar systems from possible interference.

88. Finally, what measures should be taken to protect non-radar systems that operate in the U-NII-2B and U-NII-4 bands and what is the cost implication for manufacturers, vendors and consumers? The Commission seeks comment on what types of sharing technology or techniques could be used to protect non-radar systems, such as the DSRCS which includes both road side units (RSU-fixed) and on board units (OBU-mobile) operating under a primary allocation. For example, U-NII signal detection technologies used for DFS may not be able to detect signals from incumbents other than radar systems. Could U-NII devices detect signals from both DSRC fixed and mobile stations? The Commission seeks comments on evolving technologies that may help to detect non-radar signals and to protect those operations from harmful interference.

5. NTIA 5 GHz Report

89. NTIA has published a report of its initial study on the potential for U-NII devices to share the U-NII-2B and U-NII-4 bands with incumbent Federal operations. The report includes an initial evaluation of known and proposed spectrum-sharing technologies and also completed a high-level

evaluation of the risk to Federal users if the Commission allows U-NII devices to operate in the U-NII-2B and U-NII-4 bands.

90. NTIA, in collaboration with the Federal agency members of the Policy and Plans Steering Group (PPSG), developed a work plan for evaluating the risks to Federal systems operating in the U-NII-2B and U-NII-4 bands. The plan outlined the technical and operational information necessary to perform the evaluation. Several Federal agencies also conducted preliminary electromagnetic compatibility and interference analyses to begin to quantify risks to their systems. NTIA also used input from industry stakeholders related to their projected technical and deployment parameters for U-NII devices, and reviewed domestic and international technical studies used in the development of the existing U-NII regulations in performing their study. For the study, NTIA assumed that the FCC's existing U-NII TPC and DFS regulations would be extended to the U-NII-2B and U-NII-4 bands, and that the Federal agencies will not have to alter their systems or operations to accommodate U-NII devices. The report concludes that additional analysis is needed to determine the feasibility of introducing U-NII devices into these two bands and includes a tentative schedule and milestones for quantitative study consistent with the ongoing work for WRC-15.

91. The Commission seeks comments on all aspects of the NTIA 5 GHz Report, particularly the spectrum sharing technologies and risk analysis described in the following paragraphs.

a. Spectrum Sensing Technologies

92. The report addresses three spectrum sharing technologies that might be used as reference models in the U-NII-2B and U-NII-4 bands. These are classified as sensing based, geo-location based, and beaconing/pilot channel technologies.

93. Sensing based technology. Sensing based spectrum sharing approaches enable radio devices to identify unused spectrum by assessing and determining current use of a particular frequency through, for example, transmitter detection, cooperative sensing, or interference detection. Transmitter detection is the capability of determining if a signal from another transmitter is using a frequency nearby by correlating a known signal with an unknown signal (matched filter detection), measuring signal energy

(signal detection), or utilizing statistical means. Cooperative sensing incorporates information about the spectral environment from multiple sensing devices to accurately determine if spectrum is in use. Interference detection refers to sensing changes in the local noise floor to determine if additional traffic can be tolerated by primary users.

94. Geo-Location based technology. This approach requires the development of a database infrastructure that contains information about incumbent spectrum users which, when used in combination with a geo-location system (e.g., the Global Positioning System (GPS)) and an interference-free location-data communications link, provides a mechanism to facilitate spectrum sharing with incumbents operating at fixed or known locations with known technical parameters. Geo-location spectrum-sharing technologies can be used in conjunction with a well maintained updated database to define geographic areas where device operation will and will not be permitted, or where limitations should be placed on the operating parameters to enable spectrum sharing.

95. Beaconing/pilot channel technology. In a beacon spectrum sharing approach, a new entrant's transceiver must have the ability to receive a control signal sent continuously by incumbent systems at times when transmissions by the new entrant are permitted. The new entrant may not commence transmissions if beacon signals are not received. If any beacon signal is present but then stops while the new entrant is transmitting, transmissions must cease within a specified time interval. The beacons could be a radio frequency signal sent by incumbents on designated control frequencies, or they may be signals received over a physical connection such as fiber, copper, or coaxial cable. Transmission by the new entrant would cease if any beacon signal suffers from unfavorable propagation conditions or the physical connection is lost such that the beacon signals are not properly received by the new entrant. In other words, if the new entrant cannot hear the beacon signal, it must cease transmission.

b. Risk Analysis

96. The NTIA 5 GHz Report provides an overview of the risk elements to each type of Federal operation and suggests some mitigation strategies associated with each risk element for further investigation.

97. Description of risk elements in U-NII-2B band. The report indicates that changes in radar signal parameters may impact U-NII device detection of radar and changes in U-NII device deployment and technical parameters may result in harmful interference into radar systems. The report also emphasizes that the current U-NII regulations may introduce hidden node interference and may not adequately protect current and future radar systems while changes in the existing U-NII DFS detection parameters, including channel response time, may not sufficiently shield current and future radar systems from serious degradation. The report extends the risk element to the U-NII devices operating on an adjacent channel and states this may cause harmful interference into radar systems. The report also specifies that the radar receiver interference protection criteria used to develop existing U-NII DFS regulations may not address low-level interference effects.

98. The report states that the existing U-NII signal detection technologies may not be capable of detecting UAS signals because the existing U-NII regulations were not developed to detect such signals (there is no UAS signal in the bands governed by the existing U-NII regulations) and changes to U-NII DFS detection parameters may not protect UAS operations from performance degradation. The report also points out that existing U-NII regulations were not developed to protect spaceborne receivers. The report also states that the density of U-NII devices is one of the key parameters in determining the amount of potential interference to the incumbent Federal systems.

99. Description of risk elements in U-NII-4 band. The report cites the same risks to radar systems operating in the U-NII-4 band as it cites for the U-NII-2B band discussed above. The report also states that the existing U-NII signal detection technologies may not be capable of detecting DSRC signals because the existing U-NII regulations were not originally developed to detect such signals (there is no DSRC signal in the bands governed by the existing U-NII regulations) and changes to U-NII DFS detection parameters may not protect DSRC operations from performance degradation.

C. Other Issues

1. Miscellaneous Rule Modifications

100. The Commission also believes that there are a number of other changes that need to be

considered to simplify and clarify part 15 of the rules. The Commission's analysis revealed several sections of the rules that reference procedures or provisions that are no longer in use and therefore, may no longer be necessary. The Commission has also identified sections of the rules that need to be updated with minor revisions.

2. Transition Periods

101. The Commission proposes to establish a 12-month timetable after the effective date of any new or modified rules that the Commission eventually decides to adopt in this proceeding for manufacturers to produce U-NII devices that comply with new or modified rules. The Commission also proposes to establish a 2 year timetable after the effective date of any new or modified rules for requiring that any U-NII devices manufactured in or imported into the United States for sale comply with the new or modified rules. The Commission believes that a 12-month transition period should provide sufficient time for manufacturers to design equipment that complies with any new or modified rules and to obtain equipment certification. Therefore, the Commission would provide transitional provisions in its rules to allow for the certification of U-NII devices under the current rules for up to 12 months after the new or modified rules are published in the Federal Register. Beginning 12 months after the effective date of the new or modified rules, equipment certification could no longer be obtained for U-NII devices that do not meet the new requirements. However, until the end of the 2 year transition period, the Commission would permit Class II permissive changes for equipment certified prior to the 12-month transition date as well as their continued manufacture, marketing, installation, and importation. After the end of the 2-year transition period, Class II permissive changes for such devices would not be permitted nor would their manufacture, marketing, installation, or importation. The Commission finds that these requirements would facilitate the transition to new requirements without unduly impairing the availability or cost of U-NII devices or imposing undue burdens on manufacturers, translation services providers, or the public. Comments are requested on these proposed transition provisions.

102. The Commission also proposes that U-NII devices that are already installed or in use should be grandfathered for the life of the equipment. Requiring the immediate upgrade or replacement of

existing U-NII devices would be a financial burden on operators of these devices. The Commission believes that grandfathering equipment that is installed and operating will ensure that entities will be permitted to operate their existing U-NII devices until replacement is necessary or desired due to age, malfunction, or other concerns. The Commission seeks comments on this proposal.

Initial Regulatory Flexibility Analysis

103. As required by the Regulatory Flexibility Act of 1980, as amended (RFA), the Commission has prepared this present Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities by the policies and rules proposed in this Notice of Proposed Rule Making (NPRM). Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines specified in the NPRM for comments. The Commission will send a copy of this NPRM, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA). In addition, the NPRM and IRFA (or summaries thereof) will be published in the Federal Register.

A. Need for, and Objectives of, the Proposed Rules.

104. This NPRM proposes to amend part 15 of the FCC's rules governing the operation of unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band. U-NII devices are unlicensed intentional radiators that operate in the frequency bands 5150-5350 MHz and 5470-5825 MHz that use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions. The NPRM proposes to modify certain technical requirements for U-NII devices to ensure that these devices can continue to operate successfully while protecting incumbent spectrum users.

B. Legal Basis.

105. This action is authorized under Sections 1, 4(i), 302, 303(f) and (r), 332, and 337 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 1, 4(i), 154(i), 302, 303(f) and (r), 332, 337.

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rule Will Apply.

106. The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein. The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction." In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act. A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).

107. Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. The Census Bureau defines this category as follows: "This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment." The SBA has developed a small business size standard for Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing, which is: all such firms having 750 or fewer employees. According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for part or all of the entire year. Of this total, 912 had less than 500 employees and 17 had more than 1000 employees. Thus, under that size standard, the majority of firms can be considered small.

D. Description of Projected Reporting, Record Keeping, and Other Compliance Requirements.

108. The NPRM proposes to establish a 12-month timetable after the effective date of any new

or modified rules that we eventually decide to adopt in this proceeding for manufacturers to produce U-NII devices that comply with new or modified rules. We also propose to establish a 2-year timetable after the effective date of any or modified rules for requiring that any U-NII devices manufactured in or imported into the United States for sale comply with the new or modified rules. We believe that a 12-month transition period should provide sufficient time for manufacturers to design equipment that complies with any new or modified rules and to obtain equipment certification. Therefore, we would provide transitional provisions in our rules to allow for certification of U-NII devices under the current rules for up to 12 months after the new or modified rules are published in the Federal Register. Beginning 12 months after the effective date of the new or modified rules, equipment certification could no longer be obtained for U-NII devices that do not meet the new requirements. However, until the end of the 2-year transition period, we would permit Class II permissive changes for equipment certified prior to the 12- month transition date as well as their continued manufacture, marketing, installation, and importation. After the end of the 2-year transition period, Class II permissive changes for such devices would not be permitted nor would their manufacture, marketing, installation, or importation. We find that these requirements would facilitate the transition to new requirements without unduly impairing the availability or cost of U-NII devices or imposing undue burdens on manufacturers, translation services providers, or the public.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered.

109. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.

110. The proposals contained in this Notice of Proposed Rulemaking (NPRM) are aimed at improving the sharing of the spectrum between U-NII devices and other spectrum users. This NPRM proposes to amend Part 15 of our rules governing the operation of Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band. U-NII devices are unlicensed intentional radiators that operate in the frequency bands 5.15-5.35 GHz and 5.47-5.825 GHz, and which use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions. Since the Commission first made available spectrum in the 5 GHz band for U-NII in 1997, we have gained much experience with these devices. We believe that the time is now right for us to revisit our rules, and, in this NPRM, we propose to modify certain technical requirements for U NII devices to ensure that these devices do not cause harmful interference and thus can continue to operate in the 5 GHz band and make broadband technologies available for consumers and businesses.

111. We also seek comment on making available an additional 195 megahertz of spectrum in the 5.35-5.47 GHz and 5.85-5.925 GHz bands for U-NII use. This could increase the spectrum available to unlicensed devices in the 5 GHz band by approximately 35 percent and would represent a significant increase in the spectrum available for unlicensed devices across the overall radio spectrum. The initiation of this proceeding satisfies the requirements of § 6406 (a) of the "Middle Class Tax Relief and Job Creation Act of 2012" which requires the Commission to begin a proceeding to modify part 15 of title 47, Code of Federal Regulations, to allow unlicensed U-NII devices to operate in the 5350-5470 MHz band. We believe that an increase in capacity gained from 195 megahertz of additional spectrum, combined with the ease of deployment and operational flexibility provided by our U-NII rules, would continue to foster the development of new and innovative unlicensed devices, and increase wireless broadband access and investment.

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rule

112. None.

Ordering Clauses

113. Pursuant to sections 1, 4(i), 7(a), 301, 303(f), 303(g), 303(r), and 307(e) of the Communications Act of 1934, as amended, 47 U.S.C. 151, 154(i), 157(a), 301, 303(f), 303(g), 303(r), and 307(e), and section 6406(a) of the Middle Class Tax Relief and Job Creation Act of 2012, Public Law 112-96, § 6406(a), 126 Stat. 156, 231 (2012), the Notice of Proposed Rule Making IS ADOPTED.

114. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of the Notice of Proposed Rule Making, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

List of Subjects in 47 CFR Part 15

Communications equipment.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch,
Secretary.

For the reasons discussed in the preamble, the Federal Communications Commission proposes to amend 47 CFR part 15 as follows:

PART 15 – RADIO FREQUENCY DEVICES

1. The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a, and 549

2. Section 15.215 is amended by adding a second sentence to paragraph (c) to read as follows:

§ 15.215 Additional provisions to the general radiated emission limitations.

* * * * *

(c) * * * In the case of intentional radiators operating under the provisions of Subpart E, the emission bandwidth may span across multiple frequency bands identified in that Subpart. * * *

3. Section 15.247 is amended by:

a. Revising the first sentence of paragraphs (a)(2) and (b)(3);

b. Removing paragraphs (b)(4)(i) through (iii);

c. Revising paragraph (c)(1)(ii) and the last sentence of paragraph (f) to read as follows:

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

* * * * *

(a) * * *

(2) Systems using digital modulation techniques may operate in the 902-928 MHz, and 2400-2483.5 MHz bands. * * *

(b) * * *

(3) For systems using digital modulation in the 902-928 MHz, and 2400-2483.5 MHz bands: 1 Watt. ***

* * * * *

(c) * * *

(1) * * *

(ii) Frequency hopping systems operating in the 5725-5850 MHz band that are used exclusively for fixed,

point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

* * * * *

(f) * * * The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

* * * * *

4. Section 15.403 is amended by revising paragraph (m) to read as follows:

§ 15.403 Definitions.

* * * * *

(m) Maximum Power Spectral Density. The maximum power spectral density is the maximum power in the specified measurement bandwidth, within the U-NII device operating band.

* * * * *

5. Section 15.407 is amended by:

a. Revising paragraphs (a)(3) through (6) and (b)(4);

b. Redesignating paragraphs (f) through (h) as paragraphs (g) through (i), and;

c.Adding new paragraph (f) and paragraph (j) to read as follows:

§ 15.407 General technical requirements.

(a) * * *

(3) For the band 5.725-5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 8 dBm in any 3-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23 dBi without any corresponding reduction in the transmitter peak output power or maximum power spectral

density. For fixed, point-to-point U-NII transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in peak transmitter power and maximum power spectral density for each 1 dB of antenna gain in excess of 23 dBi would be required. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

NOTE TO PARAGRAPH (a)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(5) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

(6) The ratio of the maximum peak excursion of the modulation envelope (measured in a 1 MHz bandwidth using a peak hold function) to the maximum power spectral density during an interval of continuous transmission (measured in a 1 MHz bandwidth) shall not exceed 13 dB. Each of the two maxima shall be separately determined across the full emission bandwidth. If the emission bandwidth is less than 1 MHz, the measurement may be performed in a resolution bandwidth narrower than 1 MHz but

wider than or equal to the emission bandwidth.

(b) * * *

(4) For transmitters operating in the 5.725-5.850 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

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(f) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

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(j) All U-NII Devices must contain security features to protect against modification of software by unauthorized parties.

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